

Air Climate & Energy

A Presentation to the EPA Science Advisory Board

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Earth Systems

Air

Ambient Air Quality
Pollutant Deposition

Climate

Changes in:
Temperature · Extremes
Precipitation · Sea Level

Exposures to and Effects on:

Ecosystems · Watersheds

Human Health and Communities

Responses

Mitigation
Prevention
Adaptation

Social Factors

Population · Public Health · Economy
Technology · Transportation · Behavior
Water/Food Supply · Land Use Change

Responses

Mitigation
Prevention
Adaptation

Energy

Emissions of Air
Pollutants
and Other Environmental
Stressors

Human Systems

Problem Formulation

- Identified key programmatic challenges through interactions with EPA partners (program and regional offices) and external stakeholders:
 - Multipollutant nature of air pollution
 - Impacts of climate change; adaptation/mitigation
 - Human health and environmental impacts of energy
 - Expanding/contracting scales of environmental problems
 - Social, behavioral, and economic factors that influence air quality and climate policies
- These challenges are consistent with the national research priorities identified by:
 - NAS's National Research Council (NRC)
 - EPA's Board of Scientific Counselors (BOSC)
 - Biomass Research and Development Board (BRDB)
 - National Science and Technology Council (NSTC)

Problem Statement:

Protecting health and the environment from the impacts of climate change and air quality are central 21st century challenges. These challenges are complicated by the interplay between air quality, the changing climate, and emerging energy options.

Vision:

The ACE program will provide cutting-edge scientific information and tools to support EPA's strategic goals to protect and improve air quality and take action on climate change.

ACE: Research Themes 1 & 2

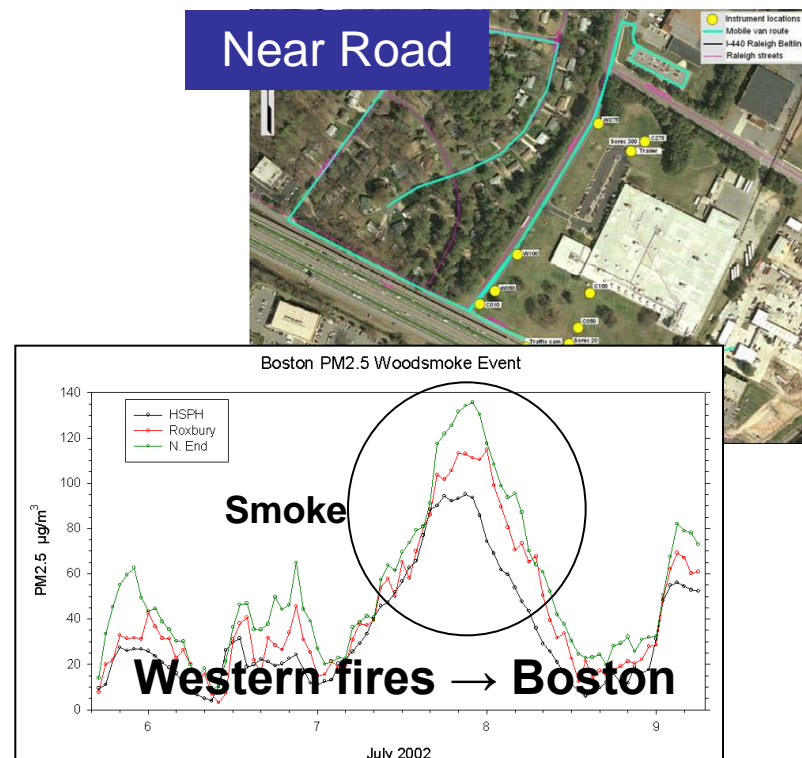
Assess Impacts

Assess human and ecosystem exposures and effects associated with air pollutants and climate change at individual, community, regional, and global scales

Prevent and Reduce Emissions

Provide data & tools to develop and evaluate approaches to prevent and reduce emissions of pollutants to the atmosphere, particularly environmentally sustainable, cost effective, and innovative multipollutant and sector-based approaches

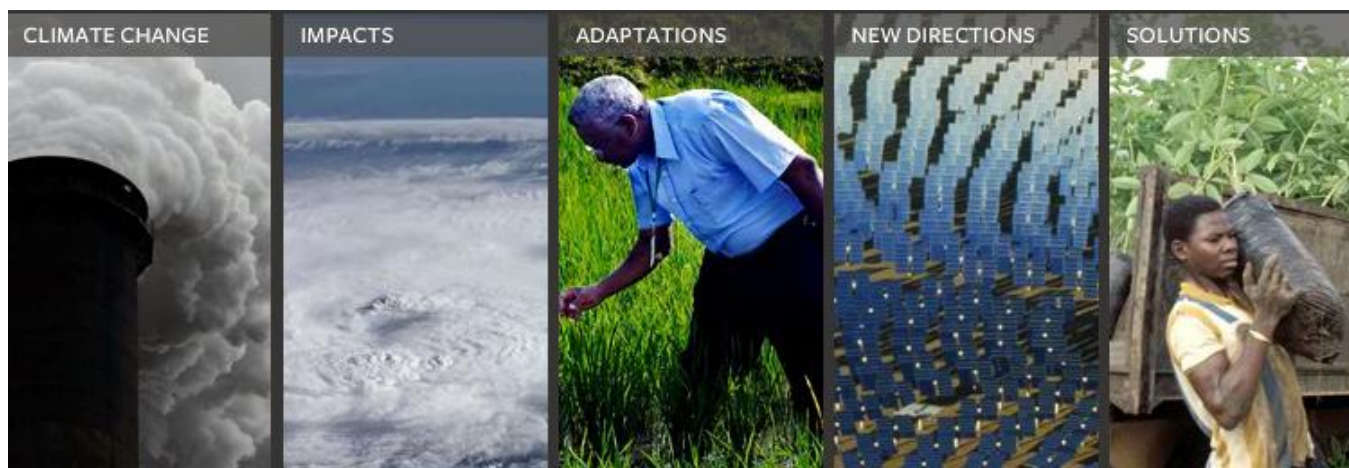
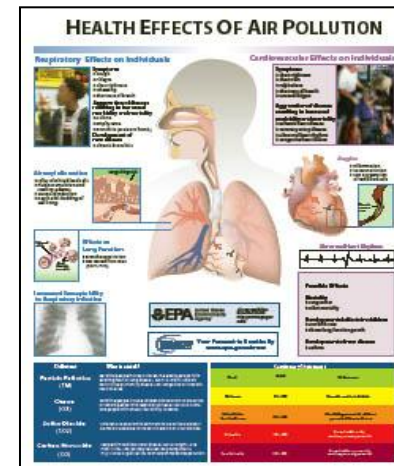
Near Road



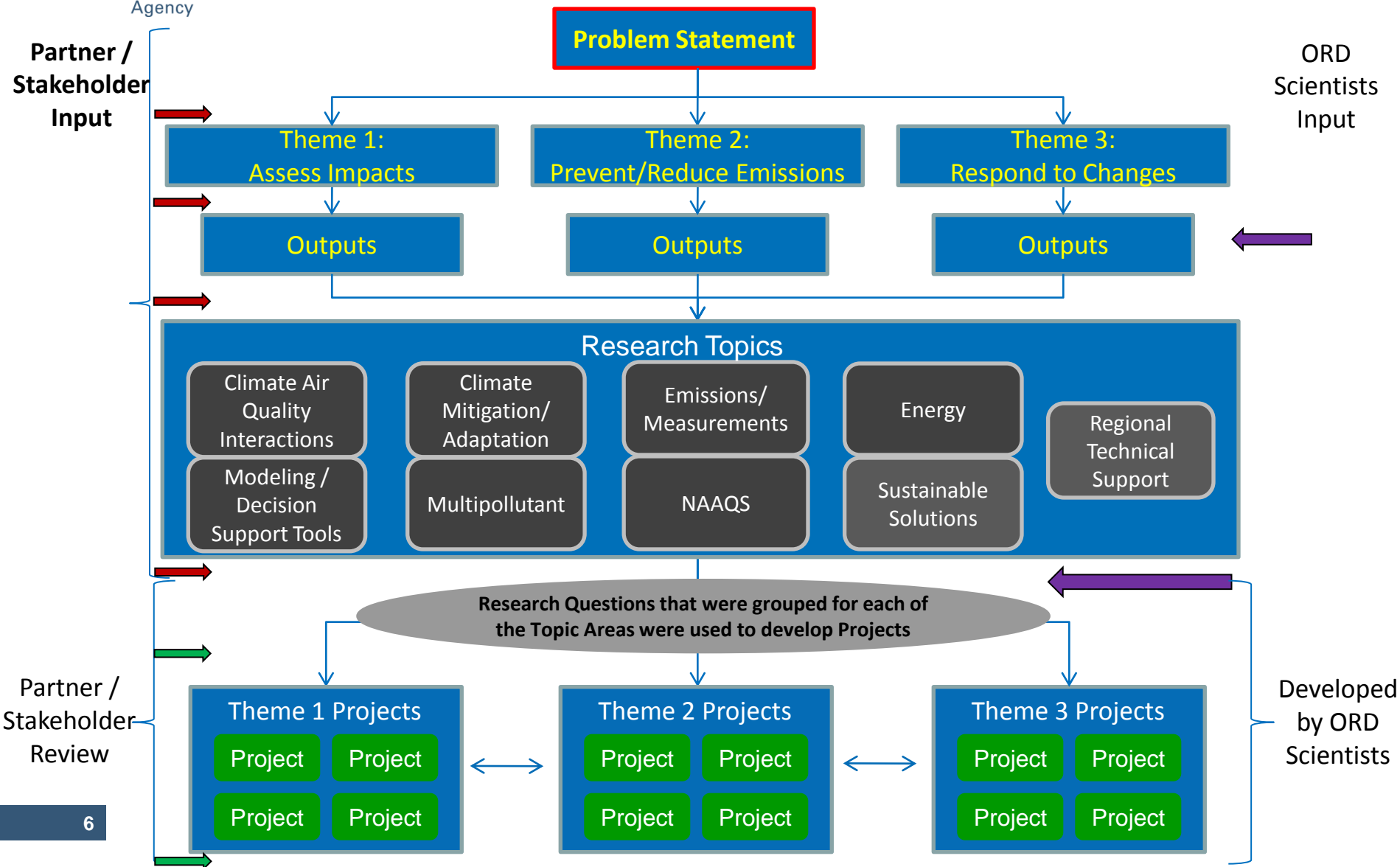
ACE: Research Theme 3

Respond to Changes in Climate & Air Quality

Provide human exposure and environmental modeling, monitoring, metrics and information needed by individuals, communities, and governmental agencies to adapt to the impacts of climate change and make informed public health decisions regarding air quality



Partner Input Was & Continues to be Critical to the ACE Process



Areas of Integration across ACE Themes

Theme 1: Assess Impacts

Multipollutant Exposures and
Effects

Innovative Assessment
Approaches

Identification of Susceptible
Populations

NAAQS Review

Theme 2: Prevent/Reduce Emissions

Tools for Multipollutant and
Multiscale AQM

Lifecycle Analysis of Energy
Alternatives

Innovative Approaches for AQM

NAAQS Implementation

Evaluation of Cost-Effective /
Sustainable Technologies

Theme 3: Respond to Changes

Identifying Adaptation Strategies
for Vulnerable Populations

Innovative Approaches for
Individual and Community
Adaptation and Decision Making

Identification of Factors Impacting
Adaptation and Decision Making

Science Questions

Areas of Integration

Multipollutant / Multiscale/
Multimedia

Innovative Measurements,
Models, and Tools

Susceptibility and
Vulnerability

NAAQS

Social, Behavioral, and
Economic Factors

Evolution of the ACE Program

Near Term Focus

Sustainable Solutions



Long-Term Vision

Energy

- Biofuels
- Biomass

NAAQS

- Research to inform review/implementation of existing NAAQS
- Single-pollutant effects in multipollutant context

Emissions/Measurements

- High priority source / ambient methods
- Key gaps in emissions inventories

Climate

- Climate-air quality interactions (black carbon, particles, meteorology)
- Climate change impacts at multiple scales

Modeling/Decision Support Tools

Enhanced air quality and emissions projections models

Energy

Life-cycle analyses/Full cost accounting of multiple energy alternatives

Multipollutant

Research to inform multipollutant air quality decisions and management

Emissions/Measurements

- Innovative measurement approaches
 - Real time methods
 - Low cost methods
- New paradigm for monitoring

Climate

Environment-Social-Economic framework to evaluate the sustainability of climate mitigation and adaptation strategies

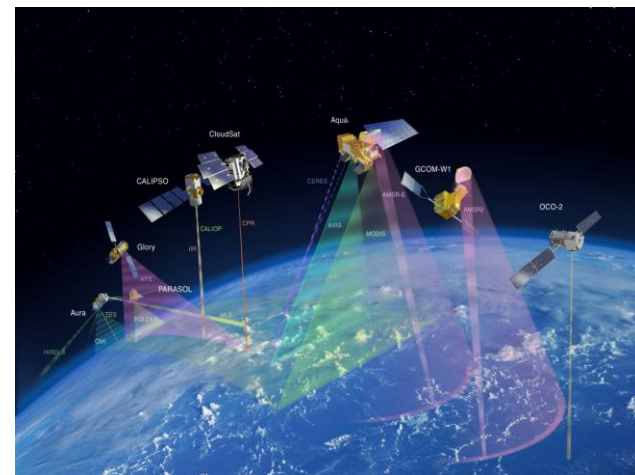
Modeling/Decision Support Tools

- Integrated modeling tools
- One-environment model

ACE Vision Project Example: Changing the Paradigm for Air Pollution Monitoring

Research Solution (Project):

- Development, evaluation, and application of innovative methods for measuring air quality
 - Development and evaluation of innovative approaches and tools (e.g., satellite data, fusion of measurements and modeling, sensor technologies).
 - Proof of concept for various monitoring objectives, including NAAQS compliance, enforcement, public information, and public health tracking.



Output:

- Fully integrated remote and local network of monitors linked by models for real-time ambient measurements for compliance, mitigation, and health research

Outcome:

- Cost-effective and more efficient monitoring tools to inform air quality management practices, advance the science, and enhance public information.



Fostering Innovation



- Innovation is a fundamental charge to the ORD scientists developing specific ACE research projects
- Innovation spawns from teams comprising diverse backgrounds and skills working as one to solve problems
- Reaching out across ORD, grantees, and the broader scientific community to solicit new ideas from scientists who have not previously been associated with ACE related research programs
- Experimenting with the use of the *Innocentive* program to solicit new ideas from external sources on measuring acrolein

"There is no more fertile ground for innovation than a diversity of experience. And that diversity of experience arises from a difference of cultures, ethnicities, and life backgrounds. A successful scientific endeavor is one that attracts a diversity of experience, draws upon the breadth and depth of that experience, and cultivates those differences, acknowledging the creativity they spark."

-Professor Joseph M. DeSimone (DeSimone Research Group - UNC Dept of Chemistry)

Synergies with ORD Research Programs

- ACE Program has MANY connections with other ORD research programs
 - Examples
 - Climate change and Energy impacts on water quality and quantity
 - Air Quality and Climate change impacts on communities
 - Impacts of community decisions on air quality and climate change
 - Research to inform Integrated Science Assessments in HHRA
 - Tools to assess exposures and effects of chemical mixtures.
- ACE is a key participant in two pilots for cross-program integration
 - Nitrogen: joint research planning effort
 - Climate: identify connections across programs and coordinate outputs
- As specific research projects are developed, additional opportunities for integration and coordination will emerge

Coordination

The ACE program will build upon and extend existing relationships and collaborations with external organizations to support the vision of the program

- Universities (notably STAR – NCER)
 - Clean Air Research Centers (CLARCS)
- Health Effects Institute (HEI)
- Federal Agencies
 - Air Quality Res. Subcom. and the Global Change Research Subcom. of the CENRS of the NSTC
 - NASA/NOAA (Air Quality Measurements)
 - Federal Highway Administration (Near road)
 - CDC (Environmental Public Health Tracking)
 - DOE (Geological Sequestration and Energy Options)
 - NIEHS and NHLBI
- State/Local Agencies
 - National Assoc. of Clean Air Agencies (NACAA)
 - North East States for Coordinated Air Use Management (NESCAUM)
- Private Sector - (e.g., EPRI, API)





Appendix

ACE Project Example: Near Road Multipollutant Exposures and Effects

Research Solution (Project):

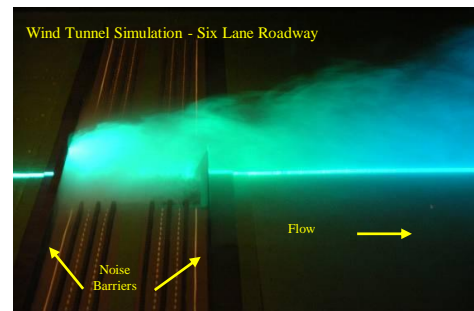
- Integrated transdisciplinary research to assess near roadway exposure and health impacts and potential options to reduce/prevent exposures – Examples...
 - Near-road Exposures and effects from Urban air pollutants Study (NEXUS); Research Triangle Area Mobile Source Emissions Study (RAMSES); Near roadway research at CLARCS
 - Field and laboratory studies of near road barriers and road designs
- Expansion of AT contributions from industry processes and evaluation of “greener” approaches

Output:

- Improved understanding of multipollutant exposure and effects to highly exposed groups.
- Evaluation of the effectiveness of near road barriers and alternative road designs to reduce/prevent exposures.

Outcome:

- Understanding of population exposure to sources (e.g., near road and resulting health effects.



ACE Examples: Energy

Research Solution (Project):

- Full cost accounting of energy choices.

Output:

- Lifecycle/systems analyses of multimedia impacts of energy and mineral extraction and injection processes (e.g., hydraulic fracturing, carbon capture and sequestration, mountain top mining).
- Lifecycle evaluation of green chemical approaches to product formulations
- Energy-based alternatives to multipollutant risk reduction
- Hierarchy selection of energy alternatives balancing benefit-cost and sustainability.

Outcome:

- Decisions incorporate a more complete understanding of the full health, environmental and multi-media cost-benefit impacts of products development, production, and use,